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DEFENSIVE BEHAVIOUR OF ADULT *PTEROHELAEUS DARLINGENSIS* CARTER (COLEOPTERA: TENEBRIONIDAE)

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Abstract

Adults of *Pterohelaeus darlingensis* Carter exhibit three types of defensive behaviour: release of a secretion from eversible abdominal glands, death-feigning and stridulation.

Introduction

Larvae of the Australian tenebrionid *Pterohelaeus darlingensis* Carter are important pests in the grain-growing areas of the Darling Downs. During studies of the population dynamics of this and other false wireworms, observations on the defense mechanisms of the adult beetle have been made.

Kendall (1974) and Tschinkel (1975a) have both reviewed and expanded the knowledge of the defensive behaviour of tenebrionids. Such mechanisms centre around the release of secretions from specialized abdominal glands. Headstanding, death-feigning and stridulation are associated with such releases. Similar behaviour has also been noted in the Australian species *Adelium percatum* (F.) and *A. pustulosum* Blackburn by Eisner *et al.* (1974). However no studies of any species of the Australian tribe Helaeini have been reported.

Materials and methods

Adults of *P. darlingensis* used in the experiments were either collected from Mt. Maria (40 km east of Toowoomba) or reared in the laboratory from specimens collected as above. Beetles were subjected to a number of stimuli: pinching of legs with forceps, tapping of elytra, handling with fingers and turning onto their dorsal surface. Examination of the structure of the glands was carried out after dissection similar to that described by Tschinkel (1975b) except fresh specimens were used and the staining step omitted.

Gland secretion

When roughly handled the beetles evert two abdominal glands which allows a secretion on the inner surface to be aired (Fig. 1). Only when the beetles are roughly handled, such as when squeezed from the sides or from the dorsal and ventral surfaces, do the glands evert. Pinching of legs or tapping of the elytra normally does not cause eversion or, at the most, causes only partial

eversion. Spraying of the secretion was not observed. Teneral adults require less stimulation to cause the glands to evert than do fully mature adults.

The glands consist of a pair of storage sacs lying ventrally in the abdomen on either side of the gut and genitalia and are formed by a modification of the intersegmental membrane between sternites 7 and 8. Each is about 1.5 mm long and 1.0 mm wide when full of secretion. The reservoirs are small (compared with those of other tenebrionids as figured by Tschinkel, 1975b), lightly wrinkled and roughly spherical in shape but ending in a small papilla. Thickened spiral bands as observed in some tenebrionids by Tschinkel are absent.

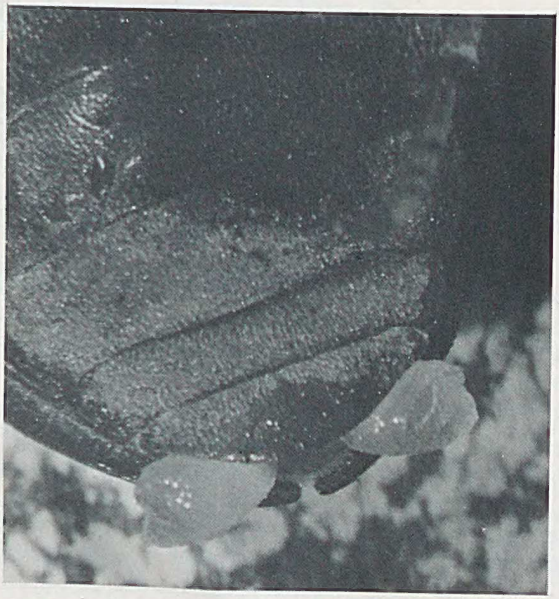

FIG. 1. Abdominal glands of *Pterohelaeus darlingensis.*

Although the chemistry of the secretion was not investigated in depth, some observations were made. After handling beetles, fingertips were always darkly mottled. The secretion when placed on filter paper impregnated with an acidified aqueous solution of potassium iodine and starch turns the paper black. Both of these observations indicate the presence of benzoquinones in the secretion (Eisner *et al*, 1974).

Postural behaviour

One of the two primary types of postural defensive behaviour which has evolved among the tenebrionids is the tendency to fold the legs and antennae close to the body and remain motionless (Tschinkel, 1975a). In *P. darlingensis* the posture of adults which are turned to their dorsal surfaces ranges from death-feigning with legs and antennae outstretched to the antennae being directed posteriad along the inner edge of the explanate lateral margins of the

pronotum and the legs scissored shut. This leg-folding posture differs somewhat from that of most of the tenebrionids studied by Tschinkel (1975a). The legs are crossed with the tibiae touching and the tibiae and tarsi are not in contact with the body. Nevertheless in all positions the beetle remains motionless for up to five minutes after the stimulus ceases; the only movement may be an eversion of the abdominal defence glands.

Stridulation

When seized, pinched or more often when overturned *P. darlingensis* adults produce a distinctly audible sound. This is produced by movement of the hind tibiae across the edge of the explanate lateral margin of the elytra. The tibiae, in addition to being setose, also have numerous short, stout spines (Fig. 2) and the beetles push the hind legs out laterally like oars, thus scraping the spines across the elytral margins. Teneral adults show this behaviour more often than do mature individuals.

FIG. 2. Hind tibia showing spines.

Discussion

Secretion of benzoquinones from abdominal glands, death-feigning and stridulation are all considered part of the defensive behaviour of a wide range of tenebrionid beetles (Tschinkel, 1975a). In structure, the abdominal glands of *P. darlingensis* most nearly correspond to that of Tschinkel's (1975b) *Tenebrio* type. They diverge from this type in that they are spherical, terminate distally in a small papilla, and their secretion appears to be composed of benzoquinones. Additional defensive behaviour, such as death-feigning, also indicates a divergence from the *Tenebrio* type.

The death-feigning posture of *P. darlingensis* also differs from that of most other tenebrionids. It is similar to that of some species of the tenebrionid *Conibius* in that the tibiae are not in contact with the body (Tschinkel, 1975a).

Stridulation occurs in a number of species of Platynotini but in this case the strigil is located on the gular region of the head and is rubbed on a plectrum located ventrally in the prothoracic head socket (Tschinkel, 1975a). Ridges on the abdominal tergite are scraped across the elytral margin to produce sounds in *Adelium pustulosum* according to Eisner *et al.* (1974). A mechanism similar to that employed by *P. darlingensis* is found in the genus *Edrotes.* These species stridulate by rubbing the metafemora, which are finely ridged on the medial surface, over the minutely serrate epipleural ridge (Doyen, 1968).

What use are these three mechanisms in the protection of the beetles? Kendall (1974) has postulated that because the majority of tenebrionids discharge their secretion only in response to rather persistent agitation, they are only effective against enemies whose predatory behaviour involves prolonged "handling" of the prey, i.e. small insectivorous mammals and some invertebrates such as ants and spiders. Insectivorous mammals such as native and introduced *Rattus*, the introduced house mouse *Mus musculus* L., and bandicoots (Peramelidae) are likely to have evolved with or are now associated with *P. darlingensis.* Invertebrate predators found in areas populated by *P. darlingensis* include a variety of carabids, ants, spiders and the earwig *Labidura truncata* Kirby. As the invertebrates are of similar size to adult *P. darlingensis* and because the integument of the beetles is relatively tough, the beetles probably have enough time to discharge their secretion and repel the predators before sustaining serious injury. Stridulation is probably also effective against a variety of invertebrate ground predators as well as birds. As suggested by Eisner *et al.* (1974), it may also function as a warning that the beetles are protected chemically thus acting as an acoustical aposematic signal. The effect of death-feigning is to make the beetle less conspicuous. All three mechanisms therefore contribute to the protection of the species.

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